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CAMPHOR—NATURAL AND SYNTHETIC.

By PERCY A. HOUSEMAN, PH.D., F.I.C.

Camphor has acquired a special interest within the last ten or twelve years on account of its synthesis on a commercial scale. It represents a good example of a growing tendency to replace natural products by artificially-prepared substances, which are either identical in properties with the materials occurring in nature, or can be profitably used as substitutes for them. The commercial synthesis of India rubber presents a similar problem which has yet to be solved.

NATURAL CAMPHOR.

Natural camphor has been known and prized for many hundred years. The camphor tree (*Cinnamomum Camphora*) belongs to the laurel family, and is indigenous to China, Japan, and Formosa. The substance known as Borneo camphor is closely related to the true camphor. Its chemical name is borneol, and it is obtained from *Dryobalanops aromatica*, which grows chiefly in Borneo and Sumatra. Borneo camphor commands a much higher price than Japanese camphor. It is used by the natives for ritualistic and medicinal purposes. Camphor is also obtained from an evergreen semishrub (*Blumea balsamifera*) which is found in Eastern India and Burma, and which yields the so-called "Ngai camphor." Within recent years, many attempts have been made to cultivate the camphor tree in other countries.[1] These experiments, however, are somewhat

[1] See, *e.g.*, *Board of Trade Journal*, July, 1907, "Camphor Trees in Federated Malay States." B. J. Eaton, Agric. Bull. Straits Settlements and Federated Malay States, 1909. Colonial Office Report, 1907, No. 527, "Camphor Trees in Ceylon." Battandier, *J. Pharm. Chem.*, 1907, 182, "Camphor Trees in Algeria." *Chemist and Druggist*, 1907, 109, "Camphor Trees in the United States." "Camphor Industry in Foreign Countries," U. S. Department of Commerce and Labor, 1910.

hazardous, for, though the tree thrives well in almost any subtropical climate, and appears not specially subject to attack by insect enemies, about fifty years must elapse before good yields of camphor are obtainable. Individual trees show great variability in the amount of camphor they yield, a phenomenon the cause of which is not well understood.

The question then naturally arises as to the extent of the camphor forests now existing. Until recent years no attempts were made to plant young trees in place of those cut down, but this wasteful policy has now been checked, especially since the Japanese assumed control of the camphor industry after the Chino-Japanese War of 1894.

Between the years 1900 and 1906 some 3,000,000 trees were planted by the Japanese monopoly, and, with the old trees assuring a sufficient supply of camphor for at least fifty years, there is no immediate prospect of a shortage in the supply of natural camphor. The competition which natural camphor encounters with the synthetic article will be treated of later.

The following table [2] shows the value of the camphor (presumably crude and refined) exported from Japan and Formosa for the years 1911–1912:

Destination	1911	1912
Hongkong	$15,438	$10,956
British India	285,500	322,000
Straits Settlements	4,034	4,900
England	327,700	362,000
France	398,000	251,500
Germany	260,000	244,500
United States	358,000	228,500
Canada	6,000	10,400
Australia	47,000	37,850
Other countries	24,000	57,800
Totals	$1,725,672	$1,530,406

The camphor output of Japan during 1911 was larger than at any time since 1902, over 2,640,000 pounds having been produced, of which 860,000 pounds were exported, 1,254,000 pounds taken by local refineries, 460,000 pounds by Japanese celluloid factories, the remainder going to general consumers.[3]

[2] *Die Chemische Industrie*, 36, 355. The figures should be accepted with reserve.

[3] Daily Consular and Trade Reports No. 229 (15th year), Sept. 28, 1912.

The imports of crude natural camphor from all sources into the United States for the fiscal year ending June 30, 1911, amounted to 3,726,319 pounds, valued at $1,118,586. For 1912 the amount was 2,154,646 pounds, valued at $682,669.[4]

China produces less camphor than Japan and Formosa. In 1912 China exported 165 tons, valued at $130,521, and in 1913, 124 tons, valued at $94,298.[5]

The world's production of camphor for 1913[6] is estimated at about 12,000,000 pounds, of which 4,600,000 pounds are credited to Formosa, 2,000,000 pounds to Japan, and 1,300,000 pounds to China, the remaining 4,000,000 being left for natural camphor produced in other countries, and for synthetic camphor.

Extraction and Refining.

The extraction of the crude camphor from the tree is a simple process. The wood is cut into chips and subjected to the action of steam in stills of primitive construction. The number of camphor stoves in Formosa in 1910 is given as 7834, and the number of camphor workers on the island as nearly 30,000.[7] Formosa supplies about one-half of the total crude camphor produced. Camphor is obtainable from all parts of the tree:[8] leaves, twigs, wood, and roots.

The crude camphor is divided into three grades, A, B, and BB, and is refined by steam distillation, sublimation, or crystallization. Refined camphor comes into the market as "flowers," "bells," or "blocks." Camphor oil is obtained as a by-product in the extraction of camphor. The oil is used in perfumery, soaps, etc., and contains many essential oils, as well as some dissolved camphor.

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[4] Daily Consular and Trade Reports No. 261 (15th year), Nov. 5, 1912.

[5] Daily Consular and Trade Reports No. 262 (17th year), Nov. 7, 1914.

[6] Daily Consular and Trade Reports No. 75 (16th year), April 1, 1913.

All of the statistics are given as they appear in the original sources of information. In some cases these statistics seem to be contradictory—possibly owing to a lack of clearness in separating figures applying to crude camphor from those applying to the refined article.

[7] "Camphor Industry in Foreign Countries," Special Consular Reports, vol. xliii, part 3, 1910.

[8] See, *e.g.*, B. J. Eaton, Agric. Bull. Straits Settlements and Federated Malay States, 1909. Beille and Lemaire, *Bull. Soc. Pharm. Bordeaux*, 53, 521. Daily Consular and Trade Reports No. 255 (16th year), Oct. 31, 1913.

Properties and Uses.

Camphor is a colorless, crystalline substance melting at 175° C. It is volatile at ordinary temperature, and its characteristic odor is said to be detectable at a dilution of 0.000005 gramme camphor in 1 litre of air. One part of camphor requires about 1000 parts of cold water for solution. It dissolves in organic solvents with ease.

Japanese camphor has a strongly dextrorotatory action on the plane of polarized light, $\alpha_{(D)} = 44.2°$ in alcoholic solution. The lævorotatory camphor occurs in the oil of *Matricaria parthenum* and is known as Matricaria camphor. It is identical with Japan camphor, except for its opposite rotatory power.

Camphor finds application chiefly in three directions:

1. *In Pharmacy.*—Camphor is used in more than thirty different forms. It is antispasmodic, a stimulant, cardiac and local anodyne, and is used in fevers, dysmenorrhœa, colic, etc. Camphor is also used as a disinfectant.

2. *In Explosives.*—Camphor is said to exercise a preservative action on blasting gelatine, but only a small quantity is used in the manufacture of explosives.

3. *In Celluloid.*—Celluloid was invented in 1869 by Hyatt in America, while Daniel Spill worked at the same time in England. The process of manufacture, expressed in a few words, consists of the incorporation of camphor with nitrocellulose and a suitable solvent such as acetone.

The celluloid industry consumes about three-fourths of the total camphor produced, a fact which will be readily understood when one thinks of the enormous number of articles now made of celluloid.

Chemical Constitution of Camphor.

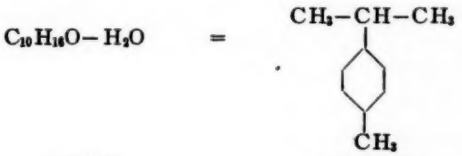
This has been a subject of such importance that it is desirable to pass in review the steps leading up to the establishment of the chemical structure of camphor.

Camphor belongs to the important class of compounds called terpenes, the parent substances of this group being unsaturated hydrocarbons possessing the empirical formula C_5H_8. The terpenes fall into four classes: (1) Hemiterpenes (C_5H_8), (2) Terpenes ($C_{10}H_{16}$), (3) Sesquiterpenes ($C_{15}H_{24}$), (4) Polyterpenes $(C_5H_8)_n$.

Camphor is a derivative of the second of the above classes, and possesses the formula $C_{10}H_{16}O$. It is a saturated compound and

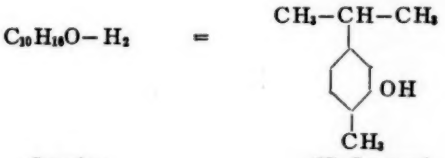
contains the ketonic group $\rangle C-CO-C \langle$, forming a well-defined oxime, and yielding a secondary alcohol (borneol) by reduction electrolytically or with sodium amalgam.

When camphor is distilled with phosphorus pentoxide the hydrocarbon cymene (I) is obtained. Cymene is para-methyl-isopropyl-benzene, and the same complex is therefore assumed to be present in camphor.



Camphor (I) Cymene

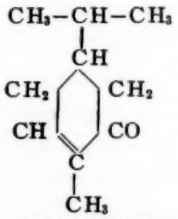
On boiling with iodine, camphor is converted to carvacrol (II), another substance of known structure.



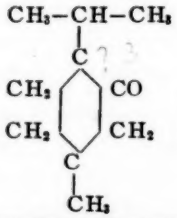
Camphor (II) Carvacrol

The reactions of camphor considered above are satisfied by the formula (III) proposed by Kekulé in 1873. This formula, however, does not account for the saturated character of camphor, nor for its oxidation to camphoronic acid.

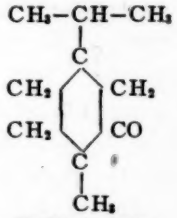
Formula (IV) was put forward by Kannonikow in 1883 and (V) by Bredt in 1884. That Bredt was correct and Kannonikow incorrect in the position assigned to the carbonyl group is proved by the conversion of camphor to carvacrol, considered above.



(III) Kekulé, 1873



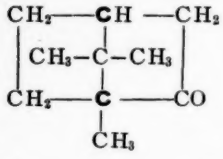
(IV) Kannonikow, 1883



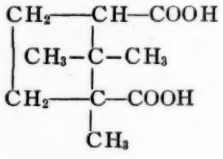
(V) Bredt, 1884

Bredt later modified his formula to that shown by (VI).

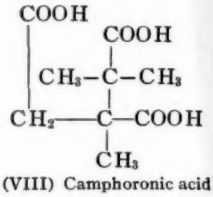
The oxidation of camphor to camphoronic acid is then formulated as follows:



(VI) Camphor (Bredt, 1893)



(VII) Camphoric acid

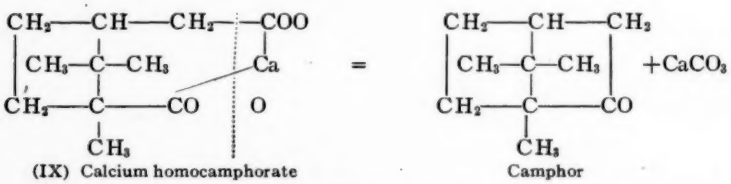


(VIII) Camphoronic acid

Camphoronic acid has been synthesized and is of known constitution (α-α-β-trimethyl tricarballylic acid). Lastly, two other points may be mentioned in connection with this complicated question of the structure of camphor.

The first is the partial synthesis of camphor by the distillation of the calcium salt of homocamphoric acid[9] (IX).

This reaction is shown thus—



(IX) Calcium homocamphorate

Camphor

The second point is the evidence derived from stereochemical considerations. From Formula (VI) it will be seen that camphor contains two asymmetric carbon atoms (printed in heavy type). To these asymmetric atoms camphor owes its optical activity. If now the carbonyl (CO) group be reduced to (CH_2), the asymmetry of both carbon atoms is destroyed, and the resulting compound must be inactive. This is entirely supported by the experimental results. Bredt's formula for camphor is the only one to interpret satisfactorily all the reactions discussed above, and his formula is now generally accepted.

Synthetic Camphor.

The raw material for the synthesis of camphor is turpentine, the resinous liquid exuding from various *Coniferæ*. American turpentine is mostly obtained from *Pinus palustris*, the French variety from

[9] Bredt and Rosenberg, *Annalen der Chemie*, 289.

Pinus maritima, and the Russian from *Pinus sylvestris.* Russian turpentine is not suitable for the manufacture of camphor, on account of its low content of pinene.

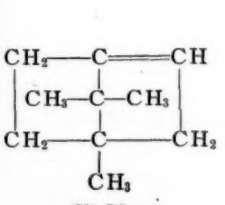
The turpentine is very carefully fractionally distilled, in order to obtain anhydrous pinene ($C_{10}H_{16}$), which boils at about 155° to 160° C., and which should constitute 90 per cent. of a good sample of oil of turpentine.

Starting out from pinene, there are a great number of variations in the processes for the preparation of camphor. Hundreds of patents have been taken out.[10] Some of the typical processes will be mentioned here.

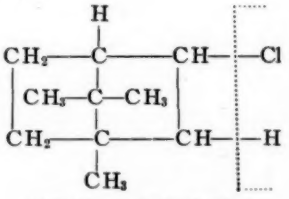
In many of the processes the pinene is thoroughly cooled, and is then saturated with dry hydrochloric acid gas. A white crystalline mass of pinene hydrochloride is thrown out. Pinene hydrochloride is sometimes called "Artificial camphor"—an unfortunate name, for it is still far removed from the true synthetic camphor, and is not suited to the purposes for which true camphor is used.

The next step is to split off hydrochloric acid from the pinene hydrochloride, in order to obtain the hydrocarbon camphene ($C_{10}H_{16}$), which is isomeric with the pinene from which the process started.

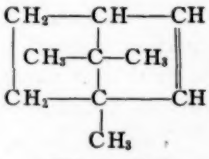
The following formulæ indicate the first two steps—the addition of hydrochloric acid to pinene in the position 1.2, and its removal from another part of the molecule, viz., the position 2.3:



(X) Pinene



(XI) Pinene hydrochloride



(XII) Camphene

The conversion of pinene hydrochloride to camphene may be accomplished in a great variety of ways, among which may be mentioned:

1. Heating with ammonia or with organic bases, such as methylamine, pyridine, quinoline, piperidine, or piperazine.

[10] *Cf.* O. Kausch, Kunststoffe 4, 1–4, 24–5. F. Rochussen, *Chem. Zeitung* (1909), 33, 704.

2. Heating with caustic soda and a salt of a higher fatty acid, such as stearates of sodium, lead, or copper.

3. Heating with phenolates or naphtholates of sodium, potassium, calcium, magnesium, etc.

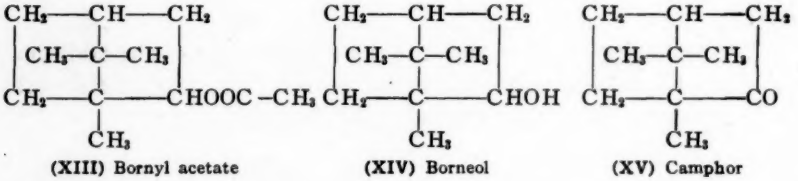
4. Heating with glacial acetic acid and anhydrous acetates of lead, zinc, or alkaline earth metals.

5. Treatment with magnesium as used in the Grignard reaction.

It is worthy of note that camphene is the only solid terpene hydrocarbon. It is a white solid melting at 50° C.

The next stage in the process is the conversion of camphene to bornyl acetate.[11] This is accomplished, as Bertram and Walbaum [12] showed, by treating the solution of the camphene in glacial acetic acid with about 5 per cent. of sulphuric acid at a slightly elevated temperature. Acetic acid is added on, in accordance with the formula below. Bornyl acetate is an oil boiling with some decomposition at about 225° C. It is readily volatile in steam.

The final steps in the camphor synthesis consist in the saponification of the bornyl acetate to borneol, and the oxidation of the borneol to camphor.



(XIII) Bornyl acetate (XIV) Borneol (XV) Camphor

The saponification is accomplished with alcoholic caustic soda, yielding sodium acetate as a by-product. The borneol so obtained is, with the exception of its optical inactivity, identical with the Borneo camphor occurring in nature.

The oxidation of borneol to camphor can be accomplished by a great variety of oxidizing agents—air, ozone, chlorine, nitric acid, potassium permanganate, potassium bichromate, and sulphuric acid, and finely divided metals such as nickel and cobalt.[13] When potas-

[11] The term bornyl acetate and borneol are used for simplicity. In reality *iso*-bornyl acetate and *iso*-borneol are produced. The nature of the isomerism is not clearly understood.

[12] *Jour. f. prak. Chem.*, NF., 49, 1.

[13] Schering, German patents 271147 and 271157. Also patent of Port Chester Chemical Company, New York (1911).

sium bichromate and sulphuric acid are used, chrome alum is obtained as a by-product.

The type of process outlined above thus involves six distinct stages before the final product is obtained:
turpentine ⟶ pinene ⟶ pinene hydrochloride ⟶ camphene ⟶ bornyl acetate ⟶ borneol ⟶ camphor.

According to a German process, the anhydrous rectified oil of turpentine is heated directly with anhydrous oxalic acid. Some camphor is formed, and the oxalic and formic esters of pinene, which are also present, are saponified and oxidized. Salicylic acid may also be employed instead of oxalic acid.

The crude camphor obtained by any of these methods is refined by steam distillation or sublimation, in the same manner as the crude natural camphor is purified.

Properties of Synthetic Camphor.

Synthetic camphor is identical with the natural article in all its chemical and physical properties, with the exception (in common with other synthetic organic compounds) that it is optically inactive. The question of the differences of physiological action of the dextro, lævo, and synthetic modifications appears not to be settled.[14] The differences seem to be of degree and not of kind.[15] Johnston[16] makes a plea for the recognition of synthetic camphor in the British Pharmacopœia, on the ground of its therapeutic equivalence to natural camphor.

As regards the chemical purity of synthetic camphor, celluloid manufacturers state that it must be quite free from chlorine for use in the preparation of celluloid.

History and Future of Camphor.

The short history of synthetic camphor since it was first made about 10 years ago has been a very troubled one, and the future of the industry still seems to be a matter of great uncertainty. This checkered career has been caused, largely by a great fluctuation in the price of natural camphor. Forty years ago the price of Japanese

[14] Langgaard and Maass, *Therapeut. Monatsh.* (1907), 20, 573. Bruni, *Gazz. Chem. Ital.* (1908), 38, (II), 1. Hämäläinen, Skan. *Arch. für Physiol.* (1908), 21, 64.

[15] See, *e.g.*, W. E. Grove, *Journ. Pharmacol.*, 1, 445.

[16] *Pharm. Journ.*, 83, 534.

camphor was about 8 cents per pound. The Japanese Government assumed a monopoly of camphor in 1899, after the Chino-Japanese War. In 1903 the price was about 30 cents per pound. At the time of the Russo-Japanese War, in 1905, the price of camphor rose to over a dollar per pound, and in 1906 and 1907 it was about 60 cents per pound. While camphor was at its highest price chemists succeeded in working out the synthetic processes outlined above, and the manufacture was commenced in Germany, France, and England. In 1909 the Japanese, with large stores on hand, reduced the price of Japanese camphor to about 30 cents per pound, a price at which it was impossible to manufacture the synthetic article. The French and English companies were unable to overcome financial difficulties, and it is believed that in 1910 only one factory was still making synthetic camphor—the Chemische Fabrik a. A. vorm. E. Schering. The price of camphor at the end of 1910 was about 35 cents per pound, and the profits from the Formosan monopoly for the fiscal year ending March 31, 1910, amounted to no less than $1,982,966, with a total production of 4,000,000 kilogrammes.[17] During the last four years the price of camphor has not varied greatly, but the outbreak of the present war has resulted in another rapid advance in price to about double the normal value.

Synthetic camphor is now being manufactured in Germany by the Rheinische Kampfer Fabrik in Düsseldorf. How long this company will be able to continue in operation is a matter of conjecture.

When much is being said of the opportunity of American chemical manufacturers to produce materials hitherto imported from Germany, it is gratifying to be able to record that a start is to be made on the manufacture of synthetic camphor in Philadelphia, early in 1915, by the American Camphor Corporation.

As to the future of synthetic camphor, it would be rash to prophesy.

The Japanese Government is now thoroughly alive to the importance of the conservation of camphor trees. Extensive replanting has been commenced, but many years will elapse before these trees will yield camphor. All of the trees in readily accessible locations have been cut down, and, though immense camphor forests still exist, they are in mountainous districts of the interior, inhabited by savage tribes.

[17] *Chem. Abst.*, 1910, 3120.

Synthetic camphor has had other enemies besides its Oriental rival. The price and supply of turpentine have been subject to considerable variation. The American manufacturer should, however, have less reason than his European competitors to fear a shortage of turpentine.

Then again, a substance may be found capable of replacing camphor in celluloid,[18] or a substitute may be found for celluloid itself. A great many experiments have already been made in this direction, largely on account of the inflammable nature of celluloid, and the work of Cross and Bevan, Knoll and Knoevenagel and others, on the non-inflammable esters of cellulose, may supply a satisfactory substitute for celluloid in the near future.

All of these questions are matters of speculation, which time will answer. In any case, synthetic camphor, whatever its commercial future may be, stands as a splendid example of achievement in the field of chemical synthesis.

PHILADELPHIA, November, 1914.

ARSENIC ANTIDOTE.

By JOSEPH W. ENGLAND.

At the 1912 annual meeting of the New York Pharmaceutical Association, Mr. Otto Raubenheimer suggested (Proc. N. Y. Pharm. Assoc., 1912, 321, *vide Journ. A. Ph. A.*, 1913, 529) the use of magma magnesia, N. F., or milk of magnesia, in place of magnesium oxide in the present official formula for making "Ferric Hydroxide with Magnesium Oxide," and the importance of the suggestion deserves much more attention than it has so far received.

To furnish an antidote against arsenic trioxide or arsenous anhydride (As_2O_3), commonly called arsenous acid or arsenic, the U. S. Pharmacopœia (VIII) recognizes, under the exceedingly cumbersome title of "Ferri Hydroxidum Cum Magnesii Oxido," a preparation containing ferric hydroxide, magnesium hydroxide, and magnesium sulphate. It is almost identical in composition with the "Antidotum Arsenici" of the German Pharmacopœia, which title, by the way, is much more descriptive than that of our Pharmacopœia.

[18] *e.g.*, German Patent 219918, 1908 (Chem. Fabrik Griesheim Elektron), which covers the use of dioxydiphenylsulphone.

If the intent of the U. S. Pharmacopœia (VIII) was to indicate the chemical composition of the preparation, the title should have been made "Ferri Hydroxidum Cum Magnesii Oxido et Magnesii Sulphate." By the time a physician finishes writing a prescription for a preparation with a title like this, the patient may be dead!

Officially, the preparation is made by adding a mixture of magnesium oxide (light calcined magnesia) and water (which becomes magnesium hydroxide) to a diluted solution of ferric sulphate, and shaking them together until a uniformly smooth mixture results.

In making the preparation, the ferric sulphate and magnesium hydroxide are decomposed into ferric hydroxide and magnesium sulphate, an excess of magnesium hydroxide being employed, which latter is partially neutralized by the free acid of the ferric sulphate solution.

The reaction is:

$$\underset{397.05}{Fe_2(SO_4)_3} + 3\underset{173.82}{Mg(OH)_2} = 2\underset{212.28}{Fe(OH)_3} + 3\underset{358.59}{MgSO_4}$$

The chemical reaction that takes place when ferric hydroxide comes into contact with arsenic trioxide or arsenous anhydride is a peculiar one. According to Attfield, the arsenous compound is oxidized, while the ferric compound is reduced—insoluble ferrous arsenate and ferrous hydrate being formed.

The reaction is:

$$\underset{424.56}{4Fe(OH)_3} + \underset{196.44}{As_2O_3} = \underset{442.34}{Fe_3(AsO_4)_2} + \underset{89.26}{Fe(OH)_2} + \underset{89.40}{5H_2O}$$

In the official process for making "Ferric Hydroxide with Magnesium Oxide" there is used solution of ferric sulphate, 40 Cc.; magnesium oxide, 10 Gms.; water, a sufficient quantity. Mix the solution of ferric sulphate with 125 Cc. of water and keep the liquid in a well-stoppered bottle. Rub the magnesium oxide with cold water to a smooth and thin mixture, transfer this to a bottle capable of holding about 1000 Cc., and fill it with water to about three-fourths of its capacity. When the preparation is wanted for use, shake the magnesium oxide mixture to a homogeneous, thin magma, add it gradually to the diluted ferric sulphate solution, and shake them until a uniformly smooth mixture results. The diluted solution of ferric sulphate and the mixture of magnesium oxide with water are directed to be always kept on hand ready for immediate use.

The Committee of Revision has decided to follow, in the ninth revision of the U. S. Pharmacopœia, the present official process for making "Ferric Hydroxide with Magnesium Oxide," but will reverse the order of mixing the iron and magnesia.

Mr. Raubenheimer suggests the following formula:

Solution of ferric sulphate	40 Cc.
Magnesia magma (milk of magnesia)...	300 Cc.
Water, a sufficient quantity.	

Mix 40 Cc. of solution of ferric sulphate with 260 Cc. of water in one bottle, and mix 300 Cc. of magnesia magma, or milk of magnesia, with 300 Cc. of water in another bottle having the capacity of 1000 Cc. When the antidote is required, add the iron solution gradually to the magnesia mixture, shake well, and the preparation is ready for instant use.

Using wine measure, it will be found convenient to keep 1¼ fluidounces of solution of ferric sulphate diluted with 8¾ fluidounces of water in one bottle, and 10 fluidounces of magnesia magma previously mixed with 10 fluidounces in water in a second bottle, having the capacity of one quart.

The advantages claimed for the preparation made by this method are:

1. The finely-suspended magnesium hydroxide in the milk of magnesia forms a smooth and finely-divided magma of ferric hydroxide.

2. Such a magma unquestionably has therapeutic advantages in combining more readily with the arsenic.

3. By pouring the iron solution into the diluted milk of magnesia a more voluminous magma will be obtained than by the reverse as directed in the U. S. Pharmacopœia.

4. Milk of magnesia, if properly prepared, is practically free from carbonate, while magnesium oxide always contains some carbonate, except when recently calcined.

It has been suggested to the Committee of Revision that, if the present official formula for the preparation be retained, an alternative process of using magnesia magma instead of magnesium oxide be authorized in the next revision of the Pharmacopœia.

A SUBSTITUTE FOR POTASSIUM PERMANGANATE TO LIBERATE FORMALDEHYDE GAS FROM A WATER SOLUTION.[1]

By SAMUEL G. DIXON, M.D., LL.D., Commissioner of Health, Commonwealth of Pennsylvania.

Almost immediately after the declaration of war by Germany I requested the department's chemist, Mr. Charles Lawall, to proceed at once to find a substitute for potassium permanganate that would liberate formaldehyde gas from a water solution for the purpose of disinfecting.

In the literature no mention of any other specific substance was found except in an English patent application (4885, *J. S. C. I.*, 1908, p. 915), where a combination of sodium bisulphite and formaldehyde solution was acted on by potassium permanganate or other peracid salt and the dry fumigation formula:

Formaldehyde, 37 per cent. solution	2 parts
Saturated alum sulphate solution	1 part

Eight ounces of this solution are used to 1 pound of lime to 1000 cubic feet.

Dr. George Rosengarten suggested sodium dichromate as a cheap oxidizing agent, and hydrochloric acid to increase its energy. Lawall found on experimenting that sodium dichromate was more energetic and satisfactory in the presence of sulphuric acid.

Numerous experiments, confirmed by calculations on the relative oxidizing power of potassium permanganate and sodium dichromate, and also working out the optimum proportion of sulphuric acid, led to the conclusion that the following proportion gave the best results, which are in every way comparable to those with potassium permanganate.

Sodium dichromate, 10 ounces avoirdupois.

Saturated solution of formaldehyde gas, 1 pint.

Sulphuric acid, commercial 1½ fluidounces.

The sulphuric acid and formaldehyde gas form a stable solution. This, after it cools, should be poured over the crystals of sodium dichromate spread out in a thin layer over the bottom of a vessel having ten times the capacity of the volume of ingredients used.

[1] *Jour. Amer. Med. Assoc.*, Sept. 19, 1914, p. 1025.

It was found that the process was more rapid than with potassium permanganate. This would necessitate the health officer's withdrawing promptly from a room in which the process had been started.

Lawall, when working on a small scale, found in every case a corrosive residue. Much to his surprise, the residue in ten minutes was dry and pulverulent, and a galvanized bucket which had been used showed very little effect of the reaction after washing out with soap and water.

He made a quantitative determination by both the permanganate and dichromate methods to determine the amount of volatile material given off, and found that in each case it approximated 8 ounces avoirdupois (or about half the weight of the formaldehyde solution taken).

As formaldehyde solution contains between 35 and 40 per cent. of gaseous HCOH, and as the residue in each case was found to be dry and particularly devoid of odor after two hours' standing, Lawall concluded that the two methods are equally effective from the quantitative standpoint.

Formaldehyde solution and commercial sulphuric acid may be kept in stock and shipped in the mixed form (10 parts of formaldehyde solution and 1 part sulphuric acid, both by volume). Lawall found the solution would be perfectly stable.

The solution would have to be handled with more care than the plain formaldehyde on account of the acid making it slightly corrosive.

THE FUNCTION OF ENZYMES.

Products of Living Cells that Affect the Chemical Operations of Living Matter but Do Not Become a Part of the Final Reaction.[1]

By Samuel C. Prescott.

The study of the chemical or physiological activity of cells, whether of microbes or of men, is at once one of the most interesting and one of the most difficult problems of the biologist, for it seeks to disclose the secrets of life processes. How does a disease germ produce its poison, or a yeast cell bring about its characteristic fer-

[1] Reprinted from *Science Conspectus*, vol. iv, 1914, No. 3, pp. 76–79.

mentation? How do we carry on those transformations of food material by which beefsteak and bread and butter at once become available sources of energy and matter for our living machine? How does a potato manufacture starch in its leaves, transfer it to the growing tubers, and there store it up for future use?

In each case by means of enzymes, which we may define as the tools of cells and the reagents by which the chemical reactions of cells of all kinds are effected.

The term "ferments" was first used early in the nineteenth century by Schwann and Berzelius. Afterwards the word was used somewhat indiscriminately, meaning either a micro-organism of fermentation or a chemical substance which in some way was related to living cells. To distinguish between these, the physiologist Kühne suggested the term "enzyme" to designate the digestive ferments such as pepsin, trypsin, and ptyalin. The word has now been universally accepted as the name of a group of chemical bodies, products of living cells, which have the peculiar property of effecting the chemical operations of living matter but which do not enter into the final products of these reactions.

Chemistry cannot produce enzymes, for they are found only as the products of protoplasm of living cells, and it makes no difference whether we are dealing with the ultra-microscopic bacterium or the giant redwood or the whale, the chemical activities are due to enzymes. Furthermore, the same kind of enzyme may be produced by organisms of widely different character, as, for example, the trypsin of certain bacteria, of the carnivorous plants like the Venus Fly Trap, and of the human intestinal tract.

Since the variety of chemical processes carried out by living cells is large in number, it follows that the number of enzymes is legion. Even the number produced by a minute bacterial cell hardly visible with a high power of the microscope may be several, while with organisms of highly specialized form and physiological division of labor the number is greatly increased. In man, at least fourteen are known to be developed in the alimentary canal, and to take part in the process of digestion, while, if we added all the other chemical changes which may be elaborated in the body as a whole, our catalogue would be greatly increased. Moreover, we may assume that there are many enzymes which are still unknown, for the enzymes may be intra-cellular, that is, acting only within the cell, as well as extra-cellular, or extruded outside the cell and so possibly

capable of detection. The positive knowledge of the action of intracellular enzymes is still very meagre, although when Büchner discovered zymase and a method for its preparation in 1897, the first great step forward in their study was made.

What an enzyme really is, cannot be exactly stated. An enzyme is known only by its reactions. "By their works ye shall know them," is essentially true in the ferment world. We cannot even tell their composition or to what class of chemical substances they belong, for they have never been obtained in pure condition. It is generally assumed, however, without proof, that enzymes are protein-like in character. In spite of this indefiniteness and the elusive character of these bodies, certain general properties regarding them have become known and on these points all enzymes behave in like manner, although differing distinctly from other chemical substances.

We may thus regard enzymes as forming a special and peculiar group of chemical compounds, differing in certain ways from other substances, and especially in their relation to the law of mass action as shown by the great disproportion between the amount of the active substance and the amount of material changed. A good example of this is rennet, which, it has been stated, can coagulate from 500,000 to 800,000 times its weight of casein without being used up. All enzymes possess the same characteristic but not necessarily in the same degree. The activity is largely dependent upon the physical and chemical conditions of the environment. Thus very slight changes in the reaction of the medium on which an enzyme is acting may control very largely its power, or make the difference between high efficiency and practical inactivity. Some enzymes require neutral solutions for action, others are most vigorous in slightly acid or slightly alkaline media.

Similarly, temperature may play a very important part in the control of enzyme reactions. In this respect, these substances behave closely like living cells and like certain kinds of proteins. Each enzyme has a maximum, a minimum, and an optimum temperature of activity, just as microbes have, and, like these, if heated above the maximum, will be rendered inactive and finally destroyed. This thermal death point, as it may be called, is very near the coagulating point of albumin and not far from the death point of most vegetative bacteria. Another similarity to the proteins lies in the fact that both enzymes and albumins are precipitated by concentrated salt solutions such as ammonium sulphate, by alcohol and by salts of heavy metals.

Furthermore, they may be more or less completely mechanically precipitated with flocculent or bulky precipitates, as by use of phosphoric acid and lime water. Certain poisons may also inactivate enzymes. Substances which kill living cells, like formaldehyde, hydrocyanic acid, or mercuric chloride, will in general " kill " enzymes, providing the solutions used are strong enough and sufficient time is allowed for the destructive action. The enzyme has a somewhat greater resistance than has the living cell, but the difference is one of degree rather than of kind. In fact, so closely do enzymes correspond to microörganisms in behavior toward physical agencies, poisons, etc., that we use the same terminology in discussing them and speak of the " poisoning " or " killing " of the enzyme. Other substances, such as toluene, chloroform, and a few others, permit enzyme reaction but restrain the activity of living cells, this giving a differentiation of great value in studying them.

Enzymes also have many properties in common with the *toxins,* and, so far as body reactions go, seem to belong to the same class of organic compounds. When a toxin is injected in small amount into the body, certain chemical changes are set up, and there is soon formed a so-called antitoxin which neutralizes or inactivates the toxin. Similarly, the action of enzymes upon the tissues of the living body is effected by the secretion of anti-enzymes, and the injection of foreign proteins into the body may be followed by the manufacture of a " precipitin " which will precipitate that particular protein and no other. This specific action is characteristic of enzymes and toxins as well as of proteins. In view of the fact that enzymes and toxins are, like proteins, the products of living cells, it may not be strange that this similarity is found. However, we are not able to say that enzymes are protein in character, but rather that they are found in association with proteins. The purest enzymes yet prepared do not give protein reactions. Moreover, mineral salts seem essential for their action.

We may explain the mechanism of fermentation and putrefaction changes on the basis of the enzymes, produced by the inciting organisms, for in recent years it has been shown that the enzymes, carefully prepared and fed from living cells, will carry on the same changes with almost mathematical precision. In yeast, for example, Büchner found within the cells an enzyme which could only be extracted by grinding with fine sand and subjecting to enormous

pressure, but which, when thus obtained, produced alcohol and carbon dioxide from sugar in exact accordance to the chemical equation which had long been used to represent the fermentation. Thus it was shown that intra-cellular enzymes exist, and we now believe that many processes taking place in living cells—perhaps all the processes —are the results of enzyme activity.

Since the chemical nature of enzymes is so largely unknown, we can classify them only by their action on various compounds. It is possible, however, to group them into the four classes of *hydrolyzing,* or causing the addition of water to certain substances. Most enzymes acting on carbohydrates are of this class. So also are those that affect fats, and the majority of those producing known proteolytic changes. These are best represented in the processes of digestion. A second group are the *Zymase,* or those producing the splitting of bodies into simpler cleavage products without any hydration. The alcoholic fermentation is the best known of this class.

The remaining two classes are the *oxidizing* and *reducing* enzymes, producing the types of change implied. Of the former, the production of vinegar is a familiar example, alcohol being oxidized to acetic acid by an *oxidase* produced by the acetic bacteria. Such familiar changes as the darkening of freshly-cut surfaces of fruits (apples) or the quick change of color when mushrooms and toadstools are broken, also belong to this category. The reduction processes are of enormous variety in nature, both in plant and animal life. While typically distinguished by the reduction of hydrogen peroxide to water and oxygen, these Katalases, as they are called, may also reduce sulphates, nitrates, and various coloring matters, as well as other compounds. Upon the activity of enzymes may depend all the complex series of changes, oxidations, reductions, synthetic and analytic changes which characterize the processes of growth and decay, renovation and destruction in the cell and in tissues. The phenomenon on intra-cellular fermentation seems to be closely linked with enzymic activity, and the building up and breaking down of protoplasm itself is intimately connected with intra-cellular changes and energy liberation.

There is reason to believe that some enzyme actions are like organic chemical reactions, reversible. Thus, maltase will split maltose into two moleculars of dextrose under the ordinary conditions of action. If, however, we add maltase to concentrated dextrose

solutions a small amount of maltose (or isomaltose, a similar sugar) will be formed, the reaction proceeding until a certain equilibrium is established. This has not been demonstrated for all enzymes, and some eminent authorities divide enzymes into two classes, only one of which is catalytic and capable of synthesizing as well as splitting substances, while in the other no trace of synthesis has been observed.

On the subject of the origin of enzymes and the causes stimulating their activity many interesting observations have been made. Some enzymes are produced by cells in such form as to require no further aid to render them active. Others require the presence of a specific substance known as an activator. The pepsin of the stomach is produced by the cells of the gastric glands as a zymogen called pepsinogen, which, under the influence of the hydrochloric acid produced at the time the stomach is functioning, becomes changed to pepsin. We do not know how the enzyme and the acid are associated, but we know that the latter is necessary for the production of pepsin and also for its action. Bayliss has described another instance in which the activator itself, enterokinase, acts as an enzyme upon the zymogen, trypsinogen, thus producing trysin, but without entering into the actual formation of the finished enzyme—trypsin. If this view is correct, we have, in effect, one enzyme bringing a second into existence. In other instances, activation is effected by metals, as in the laccase, the oxidizing enzyme of the lac tree of Asia, which requires manganese; or by salts, such as phosphates, as in certain alcoholic fermentations.

In spite of the apparent lack of exact knowledge of the composition of enzymes and of all their activities, we find in this group of substances agents which are of direct and certain application to industrial processes. Bread-making, brewing, cheese-making, certain phases of tanning, as well as the preparation of lacquers and castor oil, are a few of these applications.

Here is a field of great promise and infinite interest, sure to yield results if investigated patiently and consistently by the scientist who combines a deep knowledge of organic chemistry with an intimate acquaintance with cell behavior and activity, and this field of bio-chemistry is sure to find greater favor in the immediate future.

A PILGRIMAGE TO BRÜNN.[1]

By Dr. George H. Shull, Station for Experimental Evolution, of the Carnegie Institution of Washington, Cold Spring Harbor, L. I.

Before me on the wall of my study hangs a little clock of old-fashioned design, its three-inch enamelled dial set in a small square of pressed brass borne on a single ebonized stave, the pendulum and cylindrical brass weights attached to long, thin cords hanging free below. A visitor's attention is at once arrested by this clock because its design is unlike that of any modern American time-piece, and because its very simplicity and unpretentiousness suggest that it must have a history.

This rather obvious inference is correct, for this little clock once hung on the chamber wall of a man to whose memory the scientific men of all nations joined, in 1910, in erecting a beautiful white marble statue in Brünn, Austria, the capital city of the province of Moravia. This man was Johann Gregor Mendel, an Augustinian monk, abbot of the old Monastery or "*Königskloster*" of Brünn, who, by a careful study of garden peas during eight years, discovered the key to the age-long riddle of heredity; and this little clock is a memento of my visit to Brünn, given to me by the present abbot, Mendel's successor, Father Salesius Barcina (pronounced Bärsena).

The life of Mendel presents one of the tragic romances in scientific history, for, after making his great discovery and after publishing in the archives of the local scientific society a complete discussion of those laws of heredity which are now known as Mendel's laws, his paper lay for more than thirty years unknown to those who were sufficiently interested in the study of heredity and evolution to have appreciated their value and to have extended their applicability throughout the entire universe of plants and animals, including man, as has been done in the most complete manner during the last twelve years. Long after the patient, industrious, clear-sighted investigator had passed away in obscurity, three other men, working independently, simultaneously rediscovered the same laws, and, fortunately for the cause of justice, at the same time discovered and brought from its obscure hiding place Mendel's forgotten memoir. Thus it is that the only real laws of heredity yet known bear the

[1] Reprinted from *The Antiochian*, vol. 2, No. 8.

name of their original discoverer, Gregor Mendel, though he died in 1884 wholly unconscious of the esteem and homage the whole world would one day bestow upon him.

Having myself had a share in establishing the truth of Mendel's laws and in demonstrating their applicability to different classes of organisms, it was but natural that Brünn should appeal to me as a Mecca when, in 1908, I was given the opportunity to visit the various plant-breeding establishments and experimental students of heredity in Europe. As no experimental work is now being carried on at Brünn, my sole motive in going there was the motive which actuates all true pilgrims—a desire to tread the ground made sacred by the labors of a man of heroic mould who has performed a great service in the cause of truth and humanity.

It was early morning of the 5th of November, 1908, when I left the Victoria Hotel, Dresden, and hastened to the magnificent *Bahnhof,* or station, to take the train for Brünn, and it was already too dark to see clearly the character of the country we were passing through when I landed at my destination in the evening. It was in many respects a delightful trip, as we followed the course of the beautiful Elbe River as far as Prag, Austria, and then cut across the water-shed nearly due eastward into the valley of a small tributary of the Danube, thus providing a wide diversity of scenery to feast the traveller's eyes, and prevent the long journey from becoming unduly monotonous.

I had heard so often of the "obscurity" of the city in which Mendel had lived and worked, and in the Annals of whose scientific society he had published the account of his researches, that I was not prepared to find Brünn a busy city of a hundred thousand inhabitants, and so full of high schools, colleges, and other institutions of learning that it took me a half day to find a particular Royal Technical High School of which I had unfortunately forgotten a part of the distinctive title. At this High School I was to meet the Professor of Botany, Doctor Hugo Iltis, the secretary of a committee (of which I also was a member) which was making preparation for the erection of a suitable memorial to Mendel—a work which has since been consummated, as already mentioned. I had communicated with Doctor Iltis, and was depending upon him to escort me to the Monastery and act as guide. When, after a wearying search from one High School to another, until no less than six had been visited in vain, I at last arrived at my goal in the old part

of the city, where the "*Zweite Königliche und Kaiserliche Technische Hochschule*" faces the Klosterplatz, a small public square enclosed on two sides by the very object of my visit, the Monastery of Alt-Brünn.

A tall steel fence set on a stone base encloses the Monastery grounds from the public square, and while the outside of the enclosure was entirely barren except for a few small trees, under which were hitching posts and rails, the Monastery yard was planted to shrubbery set in a well-kept lawn traversed by smooth, hard gravel walks. In company with Dr. Iltis I entered the grounds and slowly approached the well-built stone Monastery and its beautifully proportioned Gothic chapel. The Monastery is an oblong building, three stories high, the first story being constructed like a basement except for its unusual height, and the third story is enclosed by a roof, the light being furnished by a dozen little triangular dormer windows on either side, and by a large skylight in the top. Over each of the second-story windows is cut an ornamental scroll, this being the only ornamentation which relieves the otherwise severe plainness of the cloister.

Upon presenting ourselves at the convent door we were conducted by a servant to the reception room on the second floor to await the appearance of the abbot, Father Barcina. In due time the Father came, and I was introduced as one who is devoting his life to the kind of work that Mendel did, and this introduction was an open sesame to all the interesting features of the Monastery which could be in any close way associated with the life and work of Mendel.

Father Barcina is a middle-aged man of rather stout build, round-faced, with ruddy complexion and a kindly expression. His greeting was most cordial, and, as it was already a little past noon, he inquired whether I could dine without meat (it being Friday), and, when assured that I generally do so with pleasure, he invited me to be the guest of the house for dinner. But a few minutes elapsed before dinner was announced and we descended to the first floor or basement, to the dining-room. This is a long room with high ceiling, well lighted by a row of windows on one side. Walls and ceiling are absolutely devoid of all decoration. In the centre of the room and extending nearly its whole length was a long, U-shaped table with chairs arranged along the outside of the U, the inside providing a free passage-way for the waiters who served

the meals. In the dining-room, when we entered it, were over twenty monks assembled, all dressed in long black gowns, their hair cut short and crowns shaven. Father Barcina took his place at the centre of the U, placing me on his right and Doctor Iltis on his left, the monks then arranging themselves along the sides. After a short grace spoken by Father Barcina a simple but bounteous meal was served. Eatables and drinkables of various kinds were there in abundance, but, being a teetotaler, I was permitted to devote my attention chiefly to the former. After the meal was finished, all stood while a lengthy responsive thanksgiving service was chanted, one long, thin, hollow-eyed monk taking the solo part, the rest responding in unison, making the great hall resound with their sonorous voices. This was all in Latin, of course, and, as I had been forgetting in eleven years what I had learned of Latin at Antioch in as many weeks, few of the words were intelligible to me, but the fervent expressions and the music belonged to that universal language which is neither learned nor forgotten; they were understood.

After dinner in company with the abbot and several other monks, we made a tour of the buildings and grounds. Several of the reception rooms have been purposely kept essentially in the condition in which they were when occupied by Mendel, even to having his chess-board resting open on a small table and arranged ready for his favorite game. A second favorite recreation was bowling, and the monks pointed out on the walls of the bowling-alley pencilled scores which they declared had been placed there by the former prelate. On the third floor, which is occupied by an extensive library containing many very old books, Mendel's telescope still stood on the ledge of one of the small dormer windows, for it must be remembered that Mendel's scientific interests were not narrowly limited to the problems of heredity, but he studied sunspots, and made important contributions to meteorology as well, faithfully collecting for many years the first climatological data for that section of the world. The splendid results of his investigations in heredity tend to obscure the importance of his work in other lines. Just beside the Monastery is the little garden spot in which the classic pea-experiments were performed, still enclosed by a picket fence, but not now used as a garden. On a high terrace back of the chapel is a row of bee-houses, long since unoccupied and fallen into decay, in which Mendel was also attempting to carry on experiments in heredity, but of which no detailed account has yet been

found. Nearby is the shelter in which were kept the weather-recording instruments so faithfully used almost up to the day of Mendel's death, and so completely neglected during the quarter century which has elapsed since. Below the terrace, but still in the rear of the chapel, several pear trees were pointed out which were selected seedlings of much merit, the selection having been made by Mendel.

It was with much interest that I examined Mendel's microscope, a small compound microscope without rack-and-pinion adjustment, but with a sliding tube to be simply operated by hand. A number of microscopic slides made by Mendel were also carefully examined to see whether possibly their maker might not have known something more of modern microscopic methods than could ordinarily be expected, for in recent years the development of microscopic technique has enabled cytologists to discover bodies in the cells of plants and animals, whose behavior in the germ-cells accords exactly with the observed behavior of unit-characters in Mendelian inheritance. It is now generally believed that these bodies—the chromosomes—are the producers of hereditary qualities. Not the slightest evidence was found, however, that Mendel could have anticipated the more recent discoveries regarding the structure of the living cell, though his inferences from the breeding of peas give an accurate picture of what has since been fully demonstrated by observation. His microscopic slides contained only the simplest objects, such as the epidermis stripped from the stems of plants, petals, trichomes, the feet and wings of a fly, etc. One could not fail to be impressed while examining these simple objects, and the modest instruments which Mendel had at his command, that greatness lies within the human spirit and not in elaborate equipment.

In the parlor of the Abbey hangs a splendid life-sized oil painting of Mendel in his official robes, with mitre and crozier beside him. This painting is of such excellence that I secured the privilege of taking a photographic copy of it. Mendel is shown here, as in all the photographs of him which are extant, as a man of sturdy physique, with strong, handsome, square-set face, firm but sensitive mouth, a straight and shapely, rather pugnacious nose, strong but not too large, a prominent forehead and brow, and very clear, dark eyes that seem capable of penetrating to the very centre of whatever they look at. His was obviously a harmonious organization, characterized by great strength both of intellect and will, with keen

powers of analysis, indomitable courage, and unswerving devotion to whatever task he undertook. These were the qualities that led him to analyze the problems of heredity on the basis of single characteristics, and which led him (quite unlike all previous students of the phenomena of hybridization) to continue his studies on the simplest possible material *until the problems were solved,* though it required seven years of close application and painstaking labor. The same characteristics probably cost him the satisfaction of seeing, before he died, the triumph which, by fortunate accident, has come to his work two decades after his death; for about two years after the publication of his great work he was elected to the Prelacy of the Monastery, and his time and attention were thenceforth absorbed with heavy administrative duties, and his investigations in the field of heredity came to an end. The intensity of his devotion to the problems of his institution thus prevented his following up his first report with others which would have sooner or later attracted the attention of other students.

As we proceeded on our tour of inspection, Father Barcina told me of this little clock which still hung on the chamber wall where it had been placed by Mendel, and said that when I departed he would give it to me as an "*Andenken*" of my visit. Such care had been obviously taken to preserve the relics of Mendel's existence and work at the Monastery that I feared I might be misunderstanding the Father's rather swift-moving German, but when he had repeated the statement and sent one of his brethren to pack it up for me, I knew that I had not mistaken his intention. Thus it is that I have on my study wall this little alarm-clock which may many times have wakened Mendel to an early-morning competition with the bees in hybridization experiments on the peas in his garden. I have permitted it to awaken me in the same manner, and it has also assisted in keeping awake the enthusiasm which must sustain the long-continued effort necessary to the solution of evolutionary problems.

Before taking my departure we also spent a few moments in the chapel which is attached to the Monastery by a short covered passage. This is said to be the most beautiful small chapel in central Europe. It is built of gray stone in Gothic style in the form of a cross, is splendidly harmonious in its proportions, and is not spoiled by over-decoration. The groups of statuary overlooking the apse are of real artistic merit as well as of allegorical signif-

icance, and so also are the large stained-glass windows. There is none of that cheap and tawdry over-display which spoils so many European chapels.

With many expressions of mutual pleasure in my visit, I took leave of Father Barcina, and, bearing my precious little "*Andenken,*" I went in company with Doctor Iltis to the rooms of the Natural History Society, where, in 1865, Mendel read the account of his experiments with peas. The room in which the scientific meetings are held is a plain second-floor room with simple seats and desks, resembling somewhat an ordinary school-room. Doctor Iltis endeavored to find a copy of the report of that momentous meeting, to present to me, but the very limited supply had doubtless been exhausted. He then accompanied me to the station, where I took train about 4 P.M. for Vienna, feeling that my day in Brünn had been well worth all my effort.

In recognition of his great service to science, and regretful that this service should have been so long unknown and unappreciated, the biologists of the whole world united in 1910 in erecting in the public square beside the *Königskloster* a marble statue to the memory of Gregor Mendel. This statue is of heroic size and represents Mendel in his priestly robes standing before a wall against which pea vines are growing. On the pedestal are the kneeling forms of a man and woman clasping hands to symbolize marriage and human heredity, and the words "To the Nature-Student P. Gregor Mendel, 1822–1884. Erected by friends of science." At the same time a memorial volume was issued containing Mendel's original memoirs and fourteen papers by investigators who are at the present time engaged in following out the lines of work suggested by those memoirs. The contributions to this volume belong to seven nations and have been written in three different languages, thus bearing witness to the present widespread and eager interest in the work so well begun by a keen-minded Moravian monk more than fifty years ago. The name of Mendel will soon be as familiar a household word as that of Darwin, and as knowledge of the laws of heredity becomes generally diffused his name will be revered as a benediction to the human race.

CURRENT LITERATURE.

The Friedmann Treatment for Tuberculosis.

The *furor* that attended the introduction of Friedmann's agent for the cure of tuberculosis has passed away. The nostrum, which bids fair to be one of the best sellers, is not on the American market. The history of these occurrences is interesting and offers suggestions well worth the thoughtful consideration of the pharmaceutical profession.

In Bulletin No. 99 of the Hygienic Laboratory of the United States Public Health Service, under date of October, 1914, Anderson and Stimson report the results of their investigations of the Friedmann treatment of tuberculosis, and draw the following conclusions:

"The claims made by Dr. Friedmann for his method of treating tubercular infections are, in brief, that, by means of injections of a living acid-fast organism, harmless of itself, he is able to cure cases of tuberculosis, pulmonary or otherwise, which have not already advanced to that hopeless stage where death is imminent. From the manner of presenting these claims and from the fact that successes only and not failures are reported, the reader of these claims is bound to assume that such results are the rule; in other words, that a sovereign remedy for tuberculosis has at length been discovered, and incidentally that a method has been devised for the administration of living acid-fast organisms which avoids abscess formation, a complication which has hitherto limited their employment.

"The results of the investigation here reported do not confirm the claims made by Dr. Friedmann. We find, in brief, that the preparation used by him is not strictly devoid of dangerous properties of itself, still less so when injected into tuberculous subjects; that the favorable influencing of tuberculous processes by his methods is certainly not the rule, and that if we are to ascribe to the Friedmann treatment the improvement noted in a few cases, we are equally bound to impute to it the serious retrogression observed in other cases; and, finally, that the phenomenon of abscess formation has not been avoided by Dr. Friedmann's methods.

"We find that the organism used by Dr. Friedmann differs in important cultural characteristics from any heretofore recognized tubercle bacillus.

"The subcutaneous and intramuscular inoculation of animals

with the Friedmann organism caused the formation of abscess in over 25 per cent. of the animals treated.

"The treatment of animals with the Friedmann organism—rabbits and guinea-pigs—either before or subsequent to infection with virulent tubercle bacilli, is followed, as a rule, by an increased susceptibility to the disease.

"Inoculation of monkeys with the Friedmann culture did not show either curative or protective action in those animals against tuberculosis.

"The claim of Dr. F. F. Friedmann to have originated a specific cure for tuberculosis is not substantiated by our investigation.

"The claim of Dr. F. F. Friedmann that the inoculation of persons and animals with his organism is without harmful possibilities is disproved."

The above quoted conclusions, emanating from the source they do, are accepted as unimpeachable evidence of the properties of Friedmann's agent and the impropriety of Friedmann's treatment for tuberculosis. The broad scope of the investigations reported in Bulletin 99, the laborious thoroughness and scientific skill, the unprejudiced attitude of mind with which they were executed is obvious throughout the monograph. It will serve as a most valuable guide to those engaged in any line of research. It is an inspiration to honest, efficient, unselfish service; a monument to the integrity and value of the United States Public Health Service.

The investigation included a critical study of the numerous published statements of Dr. Friedrich Franz Friedmann; the observation of 94 patients before, during, and after treatment by Dr. Friedmann; numerous tests of the effect of the agent upon guinea-pigs, rabbits, and monkeys, and an extensive bacteriological study of the spurious specific. This work, so important and extensive, is reported in clear, simple language, understandable to any layman, in 58 small pages—quite a feat in itself.

We will all enjoy reading Bulletin 99 and will be glad to learn just what Friedmann's agent is. From its perusal we gain much valuable collateral information. In the humble opinion of the writer, the most significant facts to be gleaned from it are these: Congress passed a law for the control of the importation and sale of serums, viruses, and similar biologic products used in the prevention and cure of the diseases of man. The Secretary of the Treasury exercises this

control. He bases his activities in these matters upon the findings and opinions of the Public Health Service.

The Friedmann cure, on account of its character, came under the jurisdiction of the Secretary of the Treasury. Therefore the Public Health Service investigated and disclosed the true character and effect of Friedmann's agent. As a result, it cannot be sold to any appreciable extent in this country; the charlatan cannot use this agent to quicken the hopes of victims of the white plague, extract their cash, and finally cast them into blackest despair, more complete poverty, and accentuated wretchedness. Pharmacists are delivered from a willing or unwilling prostitution of their profession without any financial loss, eventually a financial gain. This all reminds us there are many nostrums, of virulence and ill-effect greater than the Friedmann treatment, foisted upon the pharmaceutical profession and American public, to the detriment of both. Nostrums prosper in their nefarious trade because Congress has not provided for the proper control of them.

Each new spurious cure placed upon the market is a vampire that degrades and reduces the financial profits of the pharmacists; a wolf that gnaws the vitals, mutilates the body, or destroys the minds of those who take it. When the pharmaceutical profession in America coöperate in an intelligent manner, Congress will provide for the same treatment of all spurious cures as that administered to the Friedmann agent.

JOHN A. RODDY.

CORRESPONDENCE.

IN AID OF BELGIAN PHARMACISTS.[1]

AMSTERDAM, November, 27, 1914.

Various Belgian apothecaries have been brought into great difficulties on account of the war. Attempts have been made, here and in foreign countries, to provide those who have been compelled to flee from their country with a temporary working sphere. With this, however, those who went away and those who could remain in their fatherland are not helped in the long run.

When the destroyed house must now be again built up, when lost stock must be replenished, when life must again be infused into a

[1] Translation by Dr. A. W. Miller, Corresponding Secretary, Philadelphia College of Pharmacy.

paralyzed business, then money, and perhaps much money, is necessary.

It is not possible for us Netherland apothecaries to provide decisive help with our own resources. Now, it is, however, possible that we, by means of our example, can open the hearts and hands of our colleagues in those lands that have been spared from the horrors of the war.

There can naturally be no consideration of any plan for us to extend aid by means of giving alms. If we ourselves were in similar circumstances, we should not wish to accept these. We now present to you, in the name of a number of Amsterdam apothecaries, the following proposition:

We Netherland apothecaries begin with declaring ourselves ready, so that our own country may remain spared from the direct consequences of the war, to pledge our Association in the sum of 50 gilders—or more—to be placed at the disposal of the Chief Direction, with the stipulation that the Chief Direction places the money thus obtained as an advance loan, without interest, at the disposal of a commission formed of Belgian colleagues, in order to do with it that which this commission may deem to be the most desirable for the resurrection of Belgian pharmacy.

The chance is very great that this money will not be repaid, or only after a very long time. There is, however, also the possibility that the money will be returned within a reasonable time, in which case the Chief Direction is to return the money in its entirety, in divided portions or in instalments.

In that case a whole or a partial restitution to those who have advanced money should become possible, and in the beginning such a restitution must be placed in prospect.

In an assembly, attended by a comparatively large number of Amsterdam apothecaries, it was resolved to direct this circular to you, without taking counsel with the above-named Chief Direction, in consideration of the following:

Should our plan miscarry, and there were pessimists among us who held a less favorable impression of the readiness of our colleagues for making offerings, then nothing would be lost in this effort but an illusion on our part; if, however, the Chief Direction takes this matter in hand, then the good name of the Netherland apothecaries towards our Belgian colleagues and towards foreign countries will not have been endangered by a failure, and we must then again en-

deavor, in an unofficial manner, to find some other method of securing help. We do not by any means conceal the fact that many Netherland apothecaries in these times are likewise laboring under great difficulties. Contributions have also been asked of them as citizens of our land in order to furnish support for our own fellow-countrymen, who are themselves in sorrow and trouble, but we hope that in these days not only cool reason may speak, but also the heart. The inclination to give somewhat more than seems to be defensible on the score of the intellect fortunately opens many purses. And so we live also in the expectation that, in spite of all the pessimists, the Chief Direction will in this manner obtain control of over 20,000 gilders. Undoubtedly, however, there are amongst us those who, being in better circumstances for so doing, will demonstrate their sympathy for the plan by multiplying the asked-for, interest-free advance to 50 gilders.

Only fancy, dear colleague, that our Chief Direction could write to the administrations of the Apothecaries' Associations in Denmark, Norway, Sweden, Switzerland, Italy, the United States of North America, Argentina, Brazil, Chile and other States of South America, where they are everywhere filled with earnest compassion for our southern neighbors, that the Netherland Company for the Promotion of Pharmacy places 40,000 francs, perhaps even 50,000 francs, at the disposal of our Belgian colleagues as an advance loan, without interest. Our Chief Direction can at the same time then with entire propriety, and, according to our conviction, with success, invite others to work along according to their ability. Counting then the heads of those who practise pharmacy in the neutral lands, then every 50 francs that we pay in will become 1000 francs, and our 50,000 francs will become 1,000,000. Let not the pessimists among us have their way, but have the subscription blanks, which are printed next to this circular, be filled out without exception, for this loan without interest, and let them be in the possession of one of the undersigned before December 1.

L. A. Bouvy, Prinsengracht 578.
H. Th. De Groot, Rinnen Rautammerstraat 13.
J. C. Filedtok, Nassau Rade 357.
J. Haak, Ferdinand Bolstraat 11.
M. Polak, Weesperstraat 106.
J. F. Suyver, N. Z. Voorburgwal 137.
P. Van der Wielen, Willemsparkweg 209.

Subscription Blank for a Loan Without Interest in Behalf of the Belgian Apothecaries.

The Undersigned..... Address..... .....obligates himself to place the sum of .....times fifty gilders at the disposal of the Chief Direction of the Netherlands Company for the Promotion of Pharmacy, so that an advance loan, without interest, may be given to a Commission for placing the Belgian Apothecaries in condition after the war to again build up their business. This promise becomes invalid in case the Netherlands also become involved in the war.

BOOK REVIEWS.

APPLIED AND ECONOMIC BOTANY. Especially adapted for the use of students in technical schools, agricultural, pharmaceutical, and medical colleges, and also as a book of reference for chemists, food analysts, and students engaged in the morphological and physiological study of plants. By Henry Kraemer, Ph.B. (in Chemistry), Ph.M. (in Pharmacy), Ph.D. (in Botany); Professor of Botany and Pharmacognosy and Director of the Microscopical Laboratory in the Philadelphia College of Pharmacy; member of the Executive Committee of Revision of the Pharmacopœia of the United States; corresponding member of the Société de Pharmacie de Paris, etc. Illustrated, with 424 plates, comprising about 2000 figures. Published by the author, 145 North Tenth Street, Philadelphia.

This text-book of applied and economic botany is a volume singularly in harmony with the drift of thought of practical workers and decidedly in advance of present-day practices in schools and colleges. Even a casual survey of the volume impresses one with the impracticability of reflecting an adequate appreciation of the book in the limited space that can be devoted to a review in a current journal, and nothing more will be attempted at this time than the recording of a few thoughts on the probable uses of the work in the near future. To a man interested in observing the trend of commercial pursuits it is becoming more evident that a thorough knowledge of botany is essential to the practical worker, and that an intimate knowledge of vegetable cells and cell-contents is of value not alone to the pharmacist and the medical man, but also to the chemist,

the agriculturist, the engineer, and the manufacturer. Botany as an applied and economic science is only now beginning to be recognized, and the very near future will emphasize the commercial importance and economic value of practically applied botany in the manufacture, sale, and use of the food that we eat, the clothes that we wear, and the nature and content of the houses in which we live.

It goes without saying that plants and plant products enter into our everyday life to such an extent that we could not exist without them, and it is self-evident, therefore, that if we are to make material progress in the ways of benefiting humankind it will be necessary to bring botanical training and knowledge to bear on the problems involved in the production and manufacture of plant materials in ways not hitherto thought of.

Even at the present time an extended knowledge of botany and a very thorough preparation in certain phases of botanical work are required to assist the pharmacist, the chemist, and the agriculturist to meet and solve the many problems that arise in their everyday occupation, and the author of the book before us very properly points out that many of the present-day problems that are held to be chemical, and which are handed to the chemist for solution, are in reality of a botanical character, and could be solved more promptly and more economically by a properly-trained botanist.

This text-book on applied and economic botany consists of a total of 806 large octavo pages, 30 of which are devoted to a three-column index, including some 6000 titles and more than 7000 references. The illustrations are in many respects unique, being largely original and particularly well adapted to illustrate the material in the text.

The book is divided into seven chapters. The more important of these chapters are devoted to a consideration of: (1) Principal Groups of Plants; (2) Cell-contents and Forms of Cells; (3) Outer and Inner Morphology of the Higher Plants. More than one-half of the book is devoted to the discussion of Cell-contents, Forms of Cells, and the Outer and Inner Morphology of the Higher Plants. A careful study of the two chapters involved should serve to furnish a well-balanced fund of information for the practical worker or student.

The remaining chapters of the book are devoted to: (4) Botanical Nomenclature; (5) Classification of Angiosperms Yielding Economic Products; (6) Cultivation of Medicinal Plants; (7) Mi-

croscopic Technique and Reagents. The latter chapter is distinctly unique and one of the best in the book, as it presents in a compact yet sufficiently comprehensive way the information needed by the isolated worker to give him a good grasp on the technique necessary for the microscopic study of cells and cell-contents. In addition, much valuable information on microscopical technique is to be found wherever needed throughout the text-book. This is especially true of the chapter on cell-contents and forms of cells.

This book must be recognized as being in the nature of a pioneer in a field that in the very near future must receive the recognition and attention that is properly due it. As a pioneer in this important field the book deserves recognition on the part of all who are interested, directly or indirectly, in the economic application of a practical knowledge of botany to the everyday needs of the human race.

M. I. W.

COMPTE RENDU DE XIME CONGRÈS INTERNATIONAL DE PHARMACIE. Tenu à La Haye-Schéveningue du 17 au 21 Septembre, 1913. La Haye, De Avondpostdrukkerij, 1913.

The Proceedings of the Eleventh International Congress of Pharmacy, held at The Hague, Holland, September 17 to 21, 1913, have finally been published in two large octavo volumes, containing a total of 1352 pages, 32 of which are devoted to the index. Many of the papers presented at the several sections of the Congress have been previously published in pharmaceutical and chemical journals, but their collective presentation in the handsome form in which the Dutch Pharmaceutical Association finally publishes them will be appreciated by all of the members of the Eleventh International Congress. It may be said, without fear of contradiction, that these volumes present, perhaps, the most comprehensive and complete record of the proceedings of an international congress of pharmacy that has been published up to the present time. M. I. W.

YEAR-BOOK OF PHARMACY, Comprising Abstracts of Papers Relating to Pharmacy, Materia Medica, and Chemistry Contributed to British and Foreign Journals from July 1, 1913, to June 30, 1914, with the Transactions of the British Pharmaceutical Conference at its Fifty-first Annual Meeting, held in Chester, July 20–23, 1914. London, J. and A. Churchill, 7, Great Marlborough Street, 1914.

This well-known Year-Book of Pharmacy comprises a total of

513 pages, 306 of which are devoted to abstracts of articles of pharmaceutical interest prepared by the editor, J. B. Braithwaite, and conveniently arranged under the general headings Chemistry and Materia Medica. The articles under the former heading are further subdivided under: Alkaloids, Animal Products, Clinical Tests, Coloring Matters, Essential Oils, Fats, Fixed Oils and Waxes, Glucosides, Sugars and Ferments, Gums, Oleoresins, and Resins, Inorganic Chemistry, Organic Chemistry: Unclassified, and Plant Analysis. Under Materia Medica we find the headings: New Remedies, New Applications of Remedies, Pharmacognosy, Dispensing, Galenical Pharmacy, Pharmacopœia Revision Notes, and Notes and Formulæ.

The report of the Transactions of the British Pharmaceutical Conference occupies 142 pages, and the book is further made available for references by a double-column index of 38 pages. Altogether it is a creditable addition to the stately array of Year-Books published by our British *confrères,* and as a reference book will be much appreciated by pharmacists throughout the world.

M. I. W.

Units of Weight and Measure. Definitions and Tables of Equivalents. Circular of the Bureau of Standards No. 47, Department of Commerce, Washington, Government Printing Office, 1914.

As its name suggests, this large octavo circular of 68 pages includes definitions of all fundamental units, with the most common multiples and submultiples; also a section calling attention to the distinction between the units of weight and measure and the standard weights and measures. The greater portion of the circular is devoted to tables giving the interrelation of all of the units and the fundamental equivalents from 1 to 999 units. A summary of the present status of the international metric system of the United States is appended.

M. I. W.

Goldenseal Under Cultivation. By Walter Van Fleet, Physiologist, Drug-Plant and Poisonous-Plant Investigations, United States Department of Agriculture. Farmers' Bulletin 613.

This pamphlet of 15 printed pages constitutes a valuable contribution to the literature relating to the cultivation of drug plants. The pamphlet includes an illustrated description of the goldenseal plant, a discussion of its propagation, both by root bud propagation

and by seed propagation, and an enumeration of some of the precautions to be observed in the cultivation of the plant. The author concludes that as a minor money crop goldenseal is well adapted for small growers who can meet the special requirements of the plant. Ginseng growers who are already equipped for the culture of exacting woodland plants may find in goldenseal an admirable side or succession crop. Prospective goldenseal growers should study the methods adopted by those who have been successful with ginseng and plan their equipments accordingly, as goldenseal requires essentially the same conditions as ginseng, but may be regarded generally as a less difficult crop to grow. M. I. W.

REPORT OF THE CHEMIST, UNITED STATES DEPARTMENT OF AGRICULTURE, Bureau of Chemistry, Washington, D. C., October 1, 1914. Advance sheets from Annual Reports of the Department of Agriculture, 1914.

A pamphlet of 10 printed pages, in which the work of the Bureau of Chemistry for the year ended June 30, 1913, is succinctly reviewed. Pharmacists will be particularly interested to know that "As a part of the work of the Bureau of Chemistry, seeking to maintain the standards of the United States Pharmacopœia in medicinal preparations, a complete study of certain simple household remedies was made from every pharmacy in the District of Columbia. Much carelessness in compounding by retail pharmacists was discovered. Except in the District of Columbia and the Territories, this type of control devolves upon the State, and not upon the Federal Government. It was undertaken by the Bureau in the District of Columbia not merely to protect the consumer within the District, but also for the purpose of bringing to the attention of State officials the condition of simple preparations as often dispensed by the pharmacist."

In connection with the enforcement of the food and drugs act and various other kinds of work, a number of analytical methods have been studied, including methods for the determination of citric acid; acetanilid and antipyrine in headache mixtures; nitroglycerin in tablets; papain, pepsin, and certain of the heavy metals occurring in insecticide and fungicide preparations. Some of this work has been done in coöperation with the Association of Official Agricultural Chemists.

ANNUAL REPORT OF THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES FOR THE FISCAL YEAR 1914. Washington, Government Printing Office, 1914.

This volume of 357 pages embodies a comprehensive report on the many and varied operations of the United States Public Health Service. The administrative supervision of the work of this service is conducted through the seven divisions of the Bureau, as follows: (1) Scientific research and sanitation. (2) Foreign and insular quarantine and immigration. (3) Domestic (interstate) quarantine. (4) Sanitary reports and statistics. (5) Marine hospitals and relief. (6) Personnel and accounts. (7) Miscellaneous.

At the close of the fiscal year there were on duty in the Public Health Service 46 pharmacists, as follows: Pharmacists of the first class, 16; pharmacists of the second class, 24; pharmacists of the third class, 5.

Much of the work that is of direct interest to pharmacists is done in connection with the Hygienic Laboratory, which comes under the supervision of the Division of Scientific Research and Sanitation. In the Division of Pharmacology of the Hygienic Laboratory considerable work has been done on the standardization of drugs and the study of the action and pharmacological properties of drugs Among the publications from this division are the Digest of Comments on the Pharmacopœia of the United States and on the National Formulary, and the Digest of Laws and Regulations Relating to the Possession, Use, Sale, and Manufacture of Poisons and Habit-forming Drugs. The publication of a number of articles on the chemistry, pharmacy, and pharmacology of drugs and related materials is also noted. In general, one is impressed by the fact that pharmacy and subjects more directly related to the practice of pharmacy are receiving increasing attention in work that is directly of public health interest. M. I. W.

HYGIENIC LABORATORY BULLETIN NO. 98. Digest of Comments on the Pharmacopœia of the United States of America (Eighth Decennial Revision) and on the National Formulary (Third Edition). For the Calendar Year Ending December 31, 1913. By Murray Galt Motter and Martin I. Wilbert. Washington, Government Printing Office, November, 1914.

This is the ninth bulletin of the present series of Digests of Comments, and represents a comprehensive reflection of the liter-

ature relating to Pharmacopœial subjects published during the calendar year ending December 31, 1913. The bulletin includes a total of 518 pages, 125 of which are devoted to general comments on the nature and present status of the Pharmacopœia, and 365 to comments on official articles. The preface states that the references to the more important articles and monographs are restricted to a brief statement of the title or content of the contributions referred to, and a consistent effort has been made to avoid every word or phrase not essential to a bare suggestion of the intent of the reporter or contributor quoted.

This restriction is probably imposed because of the comprehensiveness of the material to be presented, but it would appear that in connection with quotations from less accessible foreign journals, at least, additional space might be devoted to the subject matter, so as to make the references something more than a bare index. Even as an index, however, these bulletins are of value to the laboratory worker in pharmacy, and will tend to prevent unnecessary duplication of work and the accompanying waste of time.

From a practical point of view the material included in this series of "Digests" is of value in a variety of ways other than its direct value as an aid in revising our official standards. One of these many uses is suggested by the following paragraph from the Preface:

"In this, as in previous bulletins, an effort has been made to incorporate the results of analyses included in the published reports of State food and drug commissioners, or officials entrusted with the enforcement of State food and drug laws, so as to show the activities existing in various parts of the country, as well as the general conditions in the drug trade and the nature of the products used in the treatment of disease as dispensed to the consumer."

The Pharmacopœia is primarily intended to secure for the consumer pure and unadulterated drugs, and this reflection of adulterations or contaminations undoubtedly constitutes an important feature of the present series of the Digest of Comments, and is one of which the pharmacists of the country should be particularly appreciative.

Another feature of more than passing interest is embodied in the quotations relating to the development of international uniformity in the nature and strength of widely-used and potent medicaments. This subject was liberally discussed at the Eleventh International Congress of Pharmacy, held at The Hague, September 17–21, 1913, and many of the papers presented at that time are re-

viewed at some length. While it is true that the disturbance that is evidenced in Europe at the present time may tend to delay the developments of international uniformity in medicines and medicinal compounds, the general subject is of such vital importance that it can no longer be postponed indefinitely, and agitation relating to it may well be continued.

Pharmacists generally will agree that this bulletin constitutes a creditable piece of work and is a contribution of more than passing value to the progress of pharmacy.

HYGIENIC LABORATORY BULLETIN NO. 99. The Friedmann Treatment for Tuberculosis. A report of the Board appointed for its investigation. By John F. Anderson and Arthur M. Stimson. Washington, Government Printing Office, October, 1914.

This bulletin of 69 octavo pages presents the final report of the United States Public Health Service on the treatment of tuberculosis proposed by Dr. Friedrich Franz Friedmann, of Berlin, Germany. The authors, in the summary of their laboratory studies, conclude that the organism used by Dr. Friedmann is an acid-fast bacillus, morphologically similar to the tubercle bacillus. It is relatively but not completely avirulent, and apparently may, in very rare cases, cause a tubercular process on inoculation. Neither curative nor protective action against natural or inoculation tuberculosis was shown in monkeys. The claim of Dr. Friedmann to have originated a specific cure for tuberculosis is not substantiated by the investigation, and the claim that the inoculation of persons and animals with this organism is without harmful possibilities is disproved. Copies of the publications of the Public Health Service may be secured by applying to the "Surgeon General, U. S. Public Health Service, Washington, D. C."

OBITUARIES.

EDWARD H. HANCE.

Edward Hance Hance, founder and senior member of Hance Brothers & White, Inc., of Philadelphia, died on December 14, 1914, at the Germantown Hospital. He was eighty-one years old and had been ill for some time.

Mr. Hance had a long and active career. He was born in the Quaker City on November 1, 1833, and received his early education

at a private school at Gwynedd, Pa. Later he returned to Philadelphia and entered the employ of Gilbert, Wentz & Co., and of Charles Ellis, Son & Co., and became a student at the Philadelphia College of Pharmacy, from which he was graduated in 1854, the subject of his thesis being "*Chimaphila umbellata.*" He had as his classmate the late John Wyeth, both of them destined to become important figures in American manufacturing pharmacy.

In 1855 Mr. Hance engaged in the manufacture of pharmaceutical and medicinal products on a large scale, the plant being first located near Fourth Street and York Road, in 1857 on Arch Street, and 1860 at 509 North Street. Manufacturing pharmacy was then in its infancy. In 1860 he formed a co-partnership with Mr. J. Clarkson Griffith under the firm name of Hance, Griffith & Co. The business of the firm grew rapidly, and in 1867 the plant was moved to Callowhill and Marshall Streets, where it is still located. In 1869 Dr. James W. White became associated with the firm, and it became Hance Brothers & White, continuing as such until its recent incorporation as Hance Brothers & White, Inc.

Mr. Hance early identified himself with organization work. He became a member of the Philadelphia College of Pharmacy in 1857, and in the same year joined the American Pharmaceutical Association, becoming a life member.

But it was in the work of the Philadelphia Drug Exchange that he took the deepest interest. Elected as a member of the Board of Directors in 1869, he served as such for several years, and in 1873 was made president. During the following four years he was an active member of the Board of Directors. With Mr. Alexander H. Jones and Mr. H. B. Rosengarten, he was most zealous in securing protection for the drug and chemical industries of the country and promoting their development. He devoted a great deal of time to the subjects of mutual fire insurance for manufacturers and wholesalers and tax-free alcohol for use in the arts. He rendered especially valuable services at the time of the Centennial Exposition in pointing out the possibilities of growth of American manufacturing pharmacy. To his efforts and skill is credited most largely the widespread advertising that Philadelphia-made pharmaceuticals have received, both in this country and abroad.

In 1878 he was elected treasurer of the Exchange, and was continued as such until 1896, when he was, for the second time, made president. The following year he was again elected treasurer, and was

continued in that office until his demise—a total period of service as treasurer of thirty-six years.

He was one of the earliest members of the Union League, but resigned some years after the Civil War was over, and was an active member of the Philadelphia Board of Trade. He was a prime mover in the organization of the Philadelphia Bourse, being in hearty accord with the objects of that organization and actively working to make Philadelphia and its manufacturing industries most widely known.

He took, also, a deep and active interest in the management of the Germantown Hospital, of which he was a director for many years.

Mr. Hance was widely esteemed for his many lovable qualities of character. "To a large circle of friends," as has been stated, "his death has its personal, poignant regret; to the mercantile and commercial world it marks the cessation of an active force which was of strong influence in the development and upbuilding of a large and important business; while to the community in general it completes a career of effort, and enterprise that was exceptional in its fruitful accomplishments and achievements."

Mr. Hance is survived by two sons—Anthony M. Hance and Edward H. Hance, Jr.

The funeral services were held at the late residence of the deceased, 104 West Tulpehocken Street, Germantown, Philadelphia, on Thursday, December 17, 1914.

The services were conducted by Rev. Dr. C. H. Arndt, rector of Christ Protestant Episcopal Church, Germantown, and Rev. Dr. Samuel J. Upjohn, rector of the Lasher Protestant Episcopal Church, Germantown.

The honorary pallbearers were: William M. Coates, president of the Board of Trade; Harry H. Good, of New York; Harry B. Rosengarten, president of the Powers-Weightman-Rosengarten Company; Judge William H. Staake, of Common Pleas Court; Francis D. Gowen, General Counsel Pennsylvania Railroad; George E. Bartol, president of the Philadelphia Bourse; Joseph C. Fraley, of Fraley & Paul lawyers; William R. Tucker, secretary and assistant treasurer of the Philadelphia Board of Trade, and Consul for Russia; Harry B. French, president of Smith, Kline & French Company; Dr. Richard V. Mattison, president of Keasbey & Mattison Company; Richard M. Shoemaker, head of Robert Shoemaker & Co.; Walter V. Smith, president of Valentine H. Smith & Co.; A. Robinson

McIlvaine, treasurer of Edward G. Budd Manufacturing Company; Edward H. Long, head of John H. Long & Co.; Harold E. Gillingham, broker; Prof. Robert W. Blake, Thomas H. Shoemaker, and Harry A. Eveleth.

J. W. ENGLAND.

WILLIAM E. LEE.

William Estell Lee, of Philadelphia, died on July 20, 1914, at his home, after several months' illness, of heart trouble, at the age of sixty-four years.

Mr. Lee was born in Woodbury, N. J., of the late Walter B. and Martha Lee. Receiving his early education in the public schools of that town, he then studied pharmacy with B. F. Carter, of Woodbury. Later he matriculated at the Philadelphia College of Pharmacy, graduating therefrom in 1872, the subject of his thesis being "*Gnaphalium Polycephalum.*"

A few years later he opened a drug store at 2337 Brown Street, Philadelphia, where he remained for over forty years.

Mr. Lee showed his devotion to his Alma Mater. For many years he had served as a member of its Board of Trustees, and during the past college year (1913–14) he was president of the Alumni Association, and rendered it very valuable services, especially as chairman of the Committee on Membership. He was a member of the P. A. R. D. and the N. A. R. D. He joined the American Pharmaceutical Association in 1905.

He was an ardent Mason. For fifteen years he was treasurer of Olivet Lodge, No. 607, A. F. and A. M. He was a member of Harmony Chapter, No. 52, Royal and Select Masters, and Corinthian Chasseur Commandery, No. 53, K. T. He was a member also, of Marathon Senate, No. 4, O of S.; Woodbury Lodge of New Jersey, I. O. O. F.; "Goodwill Council," Legion Red Cross, and Crescent Chapter 104, O. E. S.

Mr. Lee was a member of the Olivet Covenant Presbyterian Church, and was an earnest worker in the cause of civic reform.

Since early manhood Mr. Lee took an active part in reform politics and civic movements, but only last year could he be induced to become a candidate for any office. At the last primary election he was the successful nominee for the Pennsylvania Legislature on the Washington ticket, Tenth Legislative District. His strength as a reform candidate was shown at the last election, when, as a candidate

for Select Councilman in the Fifteenth Ward, he was defeated by the " organization " by a small margin only.

Personally Mr. Lee was genial, warm-hearted, and true to the highest ideals. He believed that character was the most important thing in life, and that the dollar was only a means to an end. He did a man's work and exerted an influence for good that cannot be measured, because his deeds will long live after him. Quiet and modest, but positive in matters of principle, he practised in life those principles of religion and morality which stamped him as a man among men; he brought honor to his craft, and won the respect and love of his fellows, hundreds testifying of his aid to them in sickness and in trouble.

His widow, Nellie Florence Lee, secretary of the Women's Branch of the National Association of Retail Druggists and president of the Philadelphia Chapter of that organization, with a son, Dr. Walter Estell Lee, survives him.

The funeral was held on Thursday, July 23, at 2 P.M., from his late residence, 823 North Fourth Street, the services being conducted by Rev. Matthew J. Hyndman, of the Olivet Covenant Presbyterian Church, and the officers of the lodge. The interment was at West Laurel Cemetery. The pallbearers were: Frank B. Rohrman, president of the Philadelphia Wholesale Drug Company; William C. Neely, representing the Olivet Lodge, A. F. and A. M.; Samuel C. Henry, of the Executive Committee of the National Association of Retail Druggists; Professor Joseph P. Remington, Dean of the Philadelphia College of Pharmacy; J. W. England, of the American Pharmaceutical Association, and A. J. Kellar, president of the Philadelphia Association of Retail Druggists. The honorary pallbearers were the following directors of the Philadelphia Wholesale Drug Company: Henry C. Blair, vice-president; O. W. Osterlund, H. C. Clapham, Howard E. Siegfried, Russell T. Blackwood, and George H. Fehr. In addition, David G. Potts, Frank E. Morgan, Frank W. Fluck, and Charles E. King represented the Philadelphia Association of Retail Druggists, and J. C. Peacock, vice-president, David J. Reese, secretary, L. H. Davis, assistant secretary, and F. P. Streeper, of the Executive Committee, represented the Pennsylvania Pharmaceutical Association.

J. W. ENGLAND.

THE PHILADELPHIA COLLEGE OF PHARMACY.

Minutes of the Quarterly Meeting.

The quarterly meeting of the Philadelphia College of Pharmacy was held December 28, 1914, at 4 P.M., in the Library.

In the absence of the President, Howard B. French, on account of illness, the Second Vice-president, Joseph L. Lemberger, presided.

Sixteen members were present.

The minutes of the semi-annual meeting held September 28 were read and approved.

The minutes of the Board of Trustees for September, October, and November were read by the Registrar, J. S. Beetem, and approved.

Professor Kraemer read an abstract of several articles on "Courtesy," and commented at length on its value in business.

Professor Kraemer also read in part an appeal from the pharmacists of Amsterdam, Holland, for the financial aid of the pharmacists of the United States. (See page 78.) A discussion followed, being participated in by Messrs. Beringer, Wilbert, Poley, and Remington, when a motion prevailed to refer the subject to a committee of five, and to take a wider range, to include the pharmacists of all the nations now at war. The Chairman appointed Dr. A. W. Miller, M. I. Wilbert, Joseph P. Remington, George M. Beringer, and Henry Kraemer as the committee.

Mr. Beringer read a letter from Mr. William G. Greenawalt, of the Class of 1886, donating some very old scales, oil bottles, labels, and circulars used by his predecessors in his store at Frederick, Md., and dating back to 1827.

The thanks of the College were voted the donor.

Announcement was made of the death of three members of the College since the last meeting, viz., William H. Lacey, died September 30; Charles L. Eberle, died October 4, and Edward H. Hance, died December 14.

Mr. England said that Mr. Hance was the oldest member in point of membership, having joined the College in 1857, and, while not active in the affairs of the College, his long and active life in the manufacture of medical and pharmaceutical products merited special mention, and he moved that the Secretary be requested to convey to

the family an expression of the College's appreciation of his life and character. So ordered.

The Chairman appointed the Committee on Legislation, as follows: Theodore Campbell, Warren H. Poley, Joseph P. Remington, William L. Cliffe, Richard H. Lackey, and Samuel C. Henry.

C. A. WEIDEMANN, M.D.,
Recording Secretary.

ABSTRACTS FROM THE MINUTES OF THE BOARD OF TRUSTEES.

September 1, 1914.—Thirteen members present. The Treasurer presented his annual report, which was received and referred to the Committee on Accounts and Audit. Committee on Examinations reported that the Certificates for Proficiency in Bacteriology were finished, and those directed by the Board issued. Committee on Announcement and Publicity presented a report of the exhibit made by the College at the N. A. R. D. Convention. A number commented favorably upon the exhibit and urged the value to the College of making similar exhibits in the future. Committee on Commencement reported that the Academy of Music had been leased for June 10, 1915.

The committee appointed to prepare resolutions on the death of William E. Lee, a former member of the Board, presented the following:

"The Board of Trustees of the Philadelphia College of Pharmacy, appreciating the highly useful work of William Estell Lee in the elevation of his profession, his sterling qualities of manhood and valued and faithful services as a member of the Board of Trustees, desire to enter this testimonial of the love and affection in which he was held by his co-workers. Quiet, modest, and unassuming, positive in matters of principle, Mr. Lee was a living example of religion and morality. He possessed unusual force of character, added honor to his profession, and won the respect and esteem of his co-workers. His loss is deeply deplored, and our profound sympathies are extended Mrs. Lee in her sorrow and bereavement."

The resolution was unanimously passed and an engrossed copy ordered sent to Mrs. Lee.

Announcement was made of the recent death of Henry C. Eddy,

of the Class of 1859, and a member of the College since 1869. It was stated this was the fourth death since the annual meeting.

October 6, 1914.—Seventeen members present. A communication from the Secretary of the College was read reporting the election of the following to membership in the Board of Trustees for the ensuing three years: George M. Beringer, Joseph W. England, C. Mahlon Kline, and for one year (the unexpired term of William E. Lee), Samuel C. Henry. Committee on Instruction read a letter from Professor Kraemer recommending William F. Haase, Jr., as a student assistant. The recommendation was approved. Committee on Publicity presented the resignation of Mr. E. H. Hessler as special representative, to take effect November 1. It was accepted with regret. Mr. Poley reported that final payment of $168.30 of the Pennsylvania Scholarship Fund had been turned over to the College, making the total amount $2518.30. Applications for membership were received and referred to the Committee on Membership. A letter was read from Mrs. William E. Lee expressing appreciation of the resolution passed by the College upon the death of her husband. Announcement was made of the death of William H. Lacey, a member of the College since 1886, and of Charles L. Eberle, a member since 1867.

October 13, 1914.—Thirteen members present. The Chair introduced the new member of the Board, Mr. Samuel C. Henry, who expressed his appreciation of the honor, adding that he intended taking an active interest in everything for the good of the College. Committee on Scholarships reported the award of eleven scholarships, which was approved by the Board. In connection with this report Mr. French read the correspondence between the Secretary of the Board of Public Education and the Registrar relating to the award of the three scholarships to students from the public schools. Their awards were approved. Mr. French read the correspondence between the Secretary of the State Pharmaceutical Board and Registrar relative to a recent application for examinations, and moved that the Registrar write the Secretary, Mr. Walton, that it was the desire of the Board to work in hearty accord with the State Pharmaceutical Board. Committee on Examinations reported the name of those entitled to receive the Certificates of Proficiency in Chemistry, as follows: John Brady Evans, Lloyd Philip Griesemer, Thomas Danforth Hughes, Paul S. Rogers, Joseph Stein, and moved that certificates be granted and the names appear on the program at the next commencement. It was so ordered.

November 4, 1914.—Fourteen members present. Committee on Library reported the completion of the accessioning of all the books, and the work of cataloguing will be commenced. There were a number of purchases and gifts during the month. One hundred and sixty-three persons used the Library. Committee on Accounts and Audit reported having examined the accounts of the Treasurer, Registrar, and the AMERICAN JOURNAL OF PHARMACY and found them correct. Committee on Examinations reported the names of Henry Bristol Decker and John Henry Hoffman as having successfully passed a special examination before the Faculty and the Committee on Examinations, and recommended them to the Board for the degree of P.D. to be conferred at the next commencement, which recommendation was approved. A communication from the secretary of the College relative to the Alumni Association semi-centennial celebration was read. The Dean moved that the Board approve the proposed celebration and appoint a committee to coöperate with the committee representing the Alumni Association. It was so ordered. The Dean referred to the semi-centennial of the St. Louis College of Pharmacy. The Chairman read a communication from the St. Louis College inviting the Philadelphia College of Pharmacy to send a representative, when Mr. French moved that we accept the courteous invitation and that Dean Remington be selected to represent the College. It was so ordered. The Committee on Membership reported favorably on the application of S. L. Foster and John W. Hayes for active membership. A ballot was taken and they were unanimously elected.

November 24, 1914.—An adjourned meeting was held with twenty-three members in attendance, and, by invitation, Professors Kraemer, Lowe, and Moerk. The Chair stated the object of the meeting and a general discussion followed. Mr. Beringer read a communication from the Executive Committee of the Centennial Celebration suggesting a Christmas greeting be sent to each alumnus, accompanied by a letter from the Dean. The suggestion was favorably received and referred to the Dean.